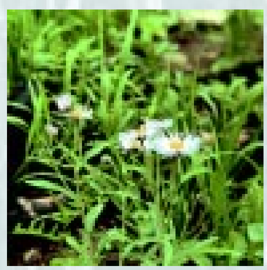
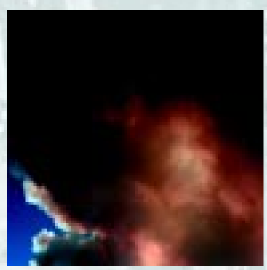
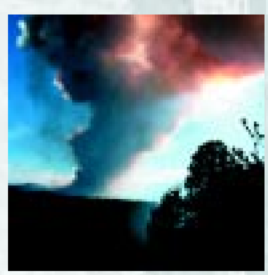
For the Seventh Generation

Environment, Safety, and Health at Los Alamos National Laboratory: A Report to Our Communities

1999–2000, Volume IV







Cover photos:
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Lightning photo, Gary Warren, Los Alamos Monitor

For the Seventh Generation

And each generation was to raise its chiefs
and to look out for the welfare of the seventh generation to come.

We were to understand the principles of living together.

We were to protect the life that surrounds us.

We were to give what we had to the elders and to the children.

What of the rights of the natural world?

Who is speaking for the waters of the earth?

Who is speaking for the trees and the forests?

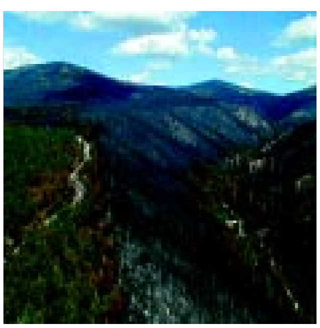
Who is speaking for our children?

We must stand for these people, and the natural world
and its rights; and also for the generations to come.

Poem based on a statement by Oren Lyons, Iroquois,
which appears in Look to the Mountain—An Ecology of Indigenous Education
by Gregory Cajete, Ph.D., Santa Clara Pueblo.

The indigenous people of North America lived in harmony with the natural environment, protecting and observing it so their way of life would be indefinitely sustainable. Every decision was examined for its long-term implications, not just for the tribe's children and grandchildren, but for the seventh generation to come. This philosophy is common amongst the Pueblo Nations of our region and is also to be found in the Great Law of the Iroquois Confederacy.




Inside *For the Seventh Generation*

On the Road to Recovery

The future is still ours. It lies in our hearts because we believe in what we are doing,
in our hands because we are not afraid of hard work,
and in our heads because it is through deliberate thought that problems are best solved.

—Terry Hawkins, Nonproliferation and International Security Division Director,
Los Alamos National Laboratory

Welcome to the 1999–2000 edition of *For the Seventh Generation—Environment, Safety, and Health at Los Alamos National Laboratory: A Report to Our Communities.* Our intent with this continuing publication is to communicate to you status and issues specific to the protection of Laboratory workers, the public, and the environment.

An initial series of reports reflects our ongoing commitments and accomplishments in improving the operations and relationships of the Laboratory. Because of the tremendous impact and the aftermath of the Cerro Grande fire, an underlying theme in this edition concerns recovery. A special series of reports has been prepared to highlight topics and activities specific to the fire.

We commend to you the message from Laboratory Director John Browne, which optimistically accepts the challenges confronting the Laboratory and the region, expresses appreciation to you and others for support of the Laboratory, and reinforces Laboratory commitment to excellence.

This publication reports on expectations and performance and on topics spanning nuclear criticality safety, a model education program at Santa Fe Indian School, the Laboratory's weather information network, and our cleanup project for legacy materials.

The articles about the Cerro Grande fire and its aftermath begin with a letter from New Mexico Governor Gary Johnson. We wish to provide information that may help clarify, explain, or further expand on important fire issues. These articles discuss the prospects for recovery, air monitoring, flood potential and mitigation, and risk management. The final article comments on the role of volunteers.

We appreciate your interest and trust that you find this report informative and meaningful. We always welcome your feedback.

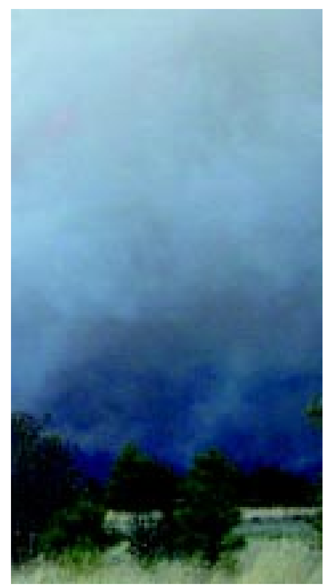
Dennis J. Erickson
Director, Environment, Safety, and Health Division

Other publications of interest concerning the Cerro Grande fire:

- A special August 2000, issue of *Reflections*, available at *http://www.lanl.gov/external/news/reflections/0900.pdf* (Kathy DeLucas, 505-667-1455)
- *A Special Edition of the SWEIS Yearbook*, *Wildfire 2000*, available at *http://lib-www.lanl.gov/la-pubs/00393627.pdf* (Doris Garvey, 505-665-8969)
- The Department of Energy's *Special Environmental Analysis for Actions Taken in Response to the Cerro Grande Fire*, available at *http://lib-www.lanl.gov/pubs/doesea-03.htm* (Elizabeth Withers, 505-667-8690)







A Message from the Laboratory Director

I am pleased to introduce this, the fourth in a series of reports to our communities on environment, safety, and health. Much has happened since the last issue. The Laboratory was challenged by two serious security incidents and, along with our neighbors in northern New Mexico, was confronted by the devastation of the Cerro Grande fire.

But the worst is over. We are on the road to recovery and I believe that we will emerge from the experience of the past year as a better Laboratory. We do well to remember that not everyone is OK. Those who lost their homes face a trying time and hard work before they will be able to "go home" again. Extra measures of compassion, understanding, and support are in order.

As we gradually return to our daily routines, we must remember to keep safety in the forefront of our thoughts. At times like this—the immediate crisis has passed but when a great deal of stress lingers—it is easy to let one's guard down and cause an accident. At work, at play, behind the wheel of a car, or wherever you may be, think "safety first" and proceed with caution.

I am proud of our Laboratory's improving safety record and the continuing development of our safety culture which, since 1996, has been increasingly based on a system of integrated safety management. As director, I have many responsibilities, but those that help our Laboratory set goals that achieve excellence in the areas of environment, safety, and health are among the most important. These goals go to the heart of our Laboratory because they affect the people who work here, the public, and our planet.

When you read this year's edition of *For the Seventh Generation,* don't just read the facts, figures, and stories of how we operate safely while protecting the environment, but also read between the lines. For it is between the lines that you will find an institution and its workers rising to the challenges of fulfilling our national mission—to enhance global security—while operating as safely as humanly possible.

I would like to thank, once again, those people who participated in fighting the Cerro Grand fire as well as those who pitched in to help with the recovery. I was truly overwhelmed by the tremendous outpouring of support from all parts of the state, the country, and the world. Thank you all. I am greatly encouraged as I look up into the burned slopes of the Jemez Mountains and see the green of new flora slowly taking over.

John C. Browne

Meeting Expectations, Safely

The University of California "shall identify the mechanism(s) to be used to ensure researchers conduct research and development safely."

—Department of Energy/University of California Contract Number: W-7405-ENG-36

In pursuing safety, no one at Los Alamos National Laboratory forgets that our primary mission is to reduce the global nuclear danger. To support workers in achieving that mission, Laboratory management has instituted an integrated safety management system. Begun five years ago, the system provides an umbrella under which Laboratory workers perform their tasks—rocket science or general maintenance—with "safety first" as a guide.

The Laboratory is operated for the Department of Energy under formal agreements contained in a contract. In recent years, the contract has become very specific about the Department's expectations of the contractor, the University of California, because all parties recognize they must establish a formal procedure for operating safely. Special provisions in the current contract, signed in 1997, cover specific areas of environment, safety, and health operations at the Laboratory.

Laboratory management embraces these provisions and is focusing efforts to meet and even exceed the requirements contained in them. The University and Department have recognized that we have been successful in achieving the following goals that are part of the special provisions:

- established facility work controls
- created facility safety plans
- demonstrated management commitment to and line ownership for formalized safe work practices
- appropriately revised the integrated safety management system
- developed and implemented an institutional requirements system
- evaluated all managers, including the Laboratory director, relative to the implementation of integrated safety management

When assessing the special provisions for environment, safety, and health at this Laboratory, the

Department of Energy recognized some of our achievements as noteworthy. One cited achievement is the development of an environmental restoration baseline that incorporates a systematic approach from planning to executing cleanup activities and projects. They also recognized significant cost-efficiencies in our waste management program and our implementation of a system that charges an organization for the waste it generates.

The Department also noted that we have room for improvement in two specific areas. The first area is increased attention on well-drilling and groundwater characterization efforts in the Environmental Restoration Program. The second area is ensuring that nitrate levels in wastewater at the Radioactive Liquid Waste Treatment Facility meet regulation limits.

Along with special provisions, the Laboratory, the Department, and the University set targets related to environment, safety, and health to measure performance. We present these targets and Laboratory performance in the next few pages.

The performance results presented here are for fiscal year 1999, which covers the period of July 1, 1998, through September 30, 1999. This time period was extended to five calendar quarters to align the fiscal year 2000 environment, safety, and health performance year with the operating fiscal year that started on October 1, 1999.

Earlier this year, an accident occurred at the Laboratory exposing eight employees to plutonium-238 (see sidebar), but also demonstrating the importance of safety management as the protective systems put in place minimized adverse consequences.

Today, as the Laboratory moves into the new millennium, we are determined to work cooperatively with the University and the Department to ensure that our workers, the environment, and the public are safer than ever before.

Plutonium Exposure

In March 2000, an accident at the Laboratory's Plutonium Facility at Technical Area 55 resulted in the exposure of eight employees to plutonium-238, a radionuclide that is used as a heat-source material.

Immediately after the accident, the Secretary of Energy ordered an accident investigation to determine cause and prevent such accidents in the future. The investigation, conducted by a panel of twelve independent experts, concluded in late April. The investigators found weaknesses in work planning and hazard analysis.

Secretary Richardson formally accepted the panel's report and authorized its release for general distribution. The Laboratory is taking aggressive action to address the panel's findings.

A barrier (like the glovebox shown above) normally in place to protect workers from hazardous material failed because of a leaking pipe connection during the course of troubleshooting a minor problem in the heat-source manufacturing process. Protective systems (alarms, emergency responders, medical treatment) functioned appropriately to limit the consequences.

At this time, all the workers are actively assigned and participate in appropriate personal monitoring.

Radiation Protection of Workers

Doses resulting from occupational exposure to radiation.

Target #1—Routine occupational radiation exposures are managed to assure that individual doses do not exceed specific limits. An effective ALARA (as low as reasonably achievable) program is in place to manage collective doses.

Performance—Based on external plus tritium-internal doses and assessed internal doses for calendar year 1998, no individual employee exceeded the dose target of 2 rem or the lifetime limit. In addition, proactive ALARA actions were implemented during the evaluation period.

Target #2—Occupational internal exposures caused by intakes of radioactive material arising from operational incidents (i.e., accidental releases from containment systems in which the amount of material released and taken into the body is unexpected) are tracked, trended, and managed with the ultimate goal being zero intakes.

Performance—No intakes of radioactive material that exceeded any dose target were identified for calendar year 1998. However, subsequent dose data indicated that one exposure did exceed a dose target, and this diminished performance will be addressed in the next performance report to the Department of Energy.

Radiation Protection of the Public

The results from data on human radiation exposures from releases of Laboratory radioactive materials into the environment and from Laboratory radiation sources.

Target #1—Releases of radioactive material will not lead to human radiation exposures over 100 mrem for the year—the Department of Energy standard for all pathways (ingestion, inhalation, etc.).

Performance—3.1 mrem in calendar year 1998. This is almost a two-fold reduction from the calendar year 1997 dose of 6.1 mrem.

Target #2—Releases of radioactive material into the atmosphere will not lead to human radiation exposure over 10 mrem for the year—the Environmental Protection Agency standard for the air pathway (inhalation).

Performance—1.7 mrem in calendar year 1998. This is a two-fold reduction from the calendar year 1997 dose of 3.5 mrem.

This measure looks at all areas of Laboratory-caused radiation exposures to the public. Data from air monitoring stations indicated a very low level of Laboratory-produced radioactive emissions for the calendar years 1998 and 1999 evaluation periods. The targets describe safe dose limits above naturally occurring radiation—radon, cosmic radiation, terrestrial radiation, and radiation from radioactive materials naturally found in the human body.

Management of Nuclear Facilities

The Laboratory operates its nuclear facilities according to Department of Energy requirements.

The overall performance was unsatisfactory; however, the Laboratory and the Department did identify ways to improve, and preliminary results for fiscal year 2000 performance indicate significant improvement.

Target #1—At least 97% of proposed facility changes are made according to the Department's procedures.

Performance—85% of proposed facility changes met the goal—unsatisfactory.

Target #2—Safety checks are completed on schedule and there are no violations of operating requirements.

Performance—All safety checks were completed on schedule, but seven violations of procedures occurred—good.

Target #3—Review safety documents for six nuclear facilities.

Performance—Reviewed nine facilities—outstanding.

Environmental Performance

The Laboratory must comply with environmental laws and regulations that apply to Laboratory operations.

Overall, the Laboratory received a score of 80 (excellent) for performance year 1999.

Target #1—No Resource Conservation and Recovery Act violations.

Performance—No notices of violations of the Act were received from the New Mexico Environment Department during the performance year. Results of 1997 and 1998 Environment Department inspections had not been received at the end of the performance year.

Target #2—No National Pollutant Discharge Elimination System exceedances.

Performance—Seventeen exceedances were recorded during the performance year. Most of these exceedances resulted during modifications to the Laboratory's Radioactive Liquid Waste Treatment Facility at Technical Area 50. These modifications are now implemented, reducing the amount of pollutant discharge from the facility and eliminating exceedances. The process that was causing the exceedances has been shut down.

Target #3—No violations of other environmental laws and regulations.

Performance—One letter of warning was received from the Environment Department regarding failure to notify the state of a demolition operation as required by air quality regulations.

Injury and Illness

The Occupational Safety and Health Act tells us which work-related injuries and illnesses are to be recorded.

In a period of three years (1994–1996), the Laboratory experienced five serious accidents, which compelled us to examine our safety culture and to take actions to eliminate injury and illness to our workers. In fiscal year 1997, we established a five-year series of annual targets. The goal is a smaller number of work-related recordable injuries and illnesses and lost workdays each year. For the first of the five years (fiscal year 1998), workers reduced these numbers at a rate better than the established target. In fiscal year 1999, workers were again successful in reducing the numbers to lower than the established target. The Laboratory received a rating of outstanding.

Target #1—For the period ending September 1999, a 35% reduction for total recordable injuries and illnesses compared to the 1996 baseline.

Performance—Workers experienced reduced injuries and illnesses equating to a reduction of 50%, which means fewer workers injured or ill than the annual target. (Approximately 300 fewer injured or ill employees relative to the 1996 baseline.)

Target #2— For the period ending September 1999, a 51% reduction for total in lost workday case rate relative to the baseline lost workday case.

Performance—Workers experienced reduced lost workday cases equating to a reduction of 60%, which means fewer lost workday cases than the annual target. (Approximately 125 more employees were able to work compared to the baseline.)

Waste Minimization

The Department of Energy determines these targets and applies them to all operating sites across the country.

Target—The Department's fiscal year 1999 goal was a 12% reduction in the generation of low-level waste, mixed low-level waste, and hazardous waste.

Performance—A 10% reduction in the generation of low-level waste, mixed low-level waste, and hazardous waste.

Nuclear Criticality: A Safe Approach to the Dragon

Nuclear fission—when an atomic nucleus splits into fragments—is the action responsible for the Nuclear Age. During World War II, Manhattan Project scientists raced time to "tickle the dragon," that is, to learn how to harness the power of nuclear fission. With this knowledge came atomic weaponry and the end of the war.

Operators teach criticality safety classes by demonstrating how thin sheets of uranium are affected by hand-stacking them, one at a time, with other material. Above the table, two neutron counters measure the rate at which neutrons are emitted from the uranium. The higher the rate, the closer the stack comes to reaching criticality, revealing the safe limits for this process and others like it.

Along with this knowledge, also came a potential energy source never before available to human-kind with benefits yet undetermined. Hence, nuclear research began with process studies in medicine, alternative fuels, and other areas, but also with the inherent danger that comes with working with the dragon—the danger of accidental criticality, which is not the same as a nuclear explosion.

A criticality accident occurs when enough fissile materials are brought together to begin a chain reaction. Once begun, the reaction leads to a release of radiation that can result in lethal exposures to people in the immediate area. Between the late 1950s and middle 1960s, about one criticality accident occurred worldwide per year; however, since the 1970s, criticality safety practices have decreased the worldwide accident frequency to about one accident every ten years, even though the production rate for fissile materials is increasing.

During World War II, the Manhattan Project gave birth to scientific expertise in fissile materials. Since then, working with fissile materials has been a special hazard here at the Laboratory. The Laboratory's mission of ensuring the reliability and safety of the nuclear stockpile requires expert knowledge of fissile materials and of safe practices for their use in various processes and experiments. This combination of knowledge and practices has resulted in an accident-free track record for the last forty years (see sidebar on next page).

Contributing to this excellent forty-year record is the Laboratory's Thomas P. McLaughlin, an internationally recognized expert in nuclear criticality safety. Building on the work of his predecessors, he and his colleagues have established a criticality safety culture that protects the worker and public from a criticality accident. The means employed to perpetuate this safety culture involve procedures, training, and other precautions, such as limiting the size of process vessels.

Within the criticality safety team, Tom has developed the important philosophy that the team's main role is to lead by teaching safety to employees who work with fissile materials. The team promotes awareness and understanding of criticality safety issues. The desired result is the assurance that criticality safety is integrated into all fissile material activities, preferably by engineered controls. This integration minimizes the chance that any failure (human or mechanical) could lead to a criticality accident.

Tom and other criticality specialists routinely conduct nuclear criticality safety courses for fissile materials handlers, their supervisors and managers, and emergency response personnel throughout the country. These courses emphasize both the theory and hands-on practice of understanding criticality and preventing accidents.

In September 1999, the twenty-second and last nuclear criticality accident of the century in process operations occurred in Tokaimura, Japan. No one was surprised when President Clinton offered Tom's services to the Japanese officials dealing with the accident, nor was anyone surprised when the Japanese accepted. During the trip, Tom and his colleagues visited the accident site and shared information with the Japan Atomic Energy Research Institute and the Japan Nuclear Cycle Development Organization.

The accident investigation determined that workers were required to mix 5 pounds of enriched uranium with an acid and water solution, but inadvertently, because of procedural misunderstandings, added 35 pounds of enriched uranium to the solution. The resulting radiation lethally exposed the two workers who were standing closest to the mixing tank.

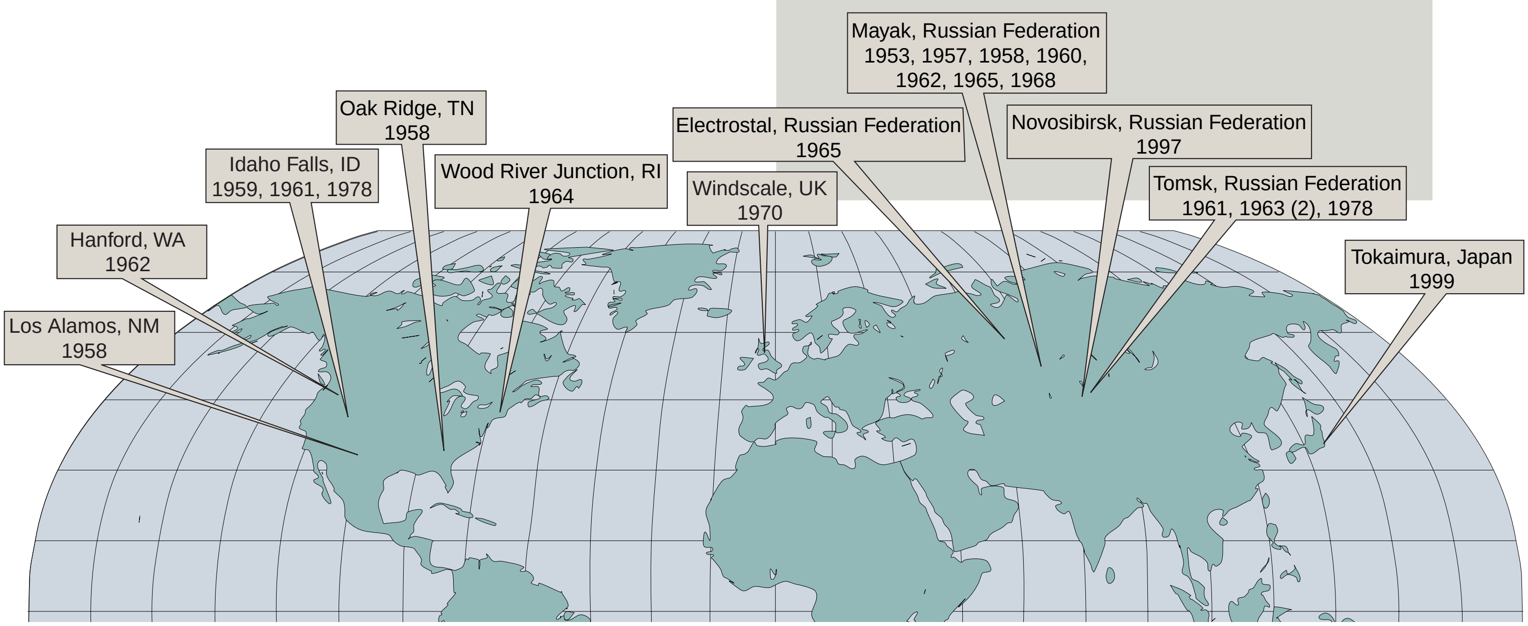
Nuclear criticality safety practices make it highly unlikely that a similar accident will endanger anyone's safety or well-being here at the Laboratory; and thanks to Tom's willingness to share his expertise, the new century may see greater nuclear criticality safety on a global scale.

Tom McLaughlin, the Laboratory's internationally recognized expert in nuclear criticality safety.

Nuclear fission is the cornerstone of today's nuclear energy industry. The enormous amount of energy released during fission and the self-sustaining chain reaction are the advantages of harnessing nuclear energy. However, only nuclear reactors are designed to produce energy from nuclear fission while providing shielding against radiation and containing the radioactive products. Other areas of nuclear energy research, such as heat-source processing or fuel cycle operations, do not have physical safeguards readily available. Hence, nuclear criticality safety—the prevention or termination of unintentional nuclear chain reactions in nonreactor environments—is very important.

Since the 1970s, criticality safety assurance practices have dramatically decreased the accident frequency worldwide (see map below). Here at Los Alamos, no criticality accident has occurred in the past forty years, with the one and only accident involving process operations occurring in 1958. However, during the days of the Manhattan Project in the 1940s, two criticality accidents occurred—one in 1945 and the other in 1946—when plutonium was being used for critical measurements.

For complete information about the criticality accidents listed below, access this latest report, *A Review of Criticality Accidents: 2000 Revision,* at *http://lib-www.lanl.gov/la-pubs/00538245.pdf or call 505-667-7628.*



Pueblo Students: Bridging the Gap Between Science and Ancient Wisdom

Looking both to yesterday and tomorrow, Irene Nakai's poem voices concern for the transition into modernity. The poem describes a unique guardianship of time and tradition within a Native American community, a community with roots deep into the earth and cherished secrets from the past. The speaker responds to the unseen unity of different people walking different paths, of the link between the past, the present, and the future: "Does it seem like we are walking as one?" The question might well be, "Would the ancient ones know us today, and will we know our children's children?"

Likewise, the high school students in the Community-Based Education Model program at Santa Fe Indian School are guardians of this unseen unity, this perpetuity of time. In this education program, student teams gather and analyze data and work with their pueblos' environmental departments. Using twenty-first century technology to conduct environmental monitoring in their pueblo communities, the students are learning to preserve their centuries-old cultural harmony with the land.

Bridge Perspective

i must be like a bridge
for my people
i may connect time;
yesterday today and tomorrow —
for my people
who are in transition, also.
i must be enough in tomorrow,
to give warning —
if i should.
i must be enough in yesterday,
to hold a cherished secret.
Does it seem like we are walking
as one?

*Irene Nakai**

This dynamic interdisciplinary program combines classroom education with hands-on field activities that involve environmental science, mathematical modeling, research, and communications. In response to a request from the pueblo governors to improve student math and science scores while at the same time cultivating student interest in their Native American heritage, Santa Fe Indian School initiated the program in 1995 with grants from the Department of Energy and Intel Corporation. The education program has a twofold purpose: to motivate student interest in science and mathematics and to motivate student interest in their pueblos, culture, and heritage.

"Pueblo members choose the real-life environmental topics and issues for students to work on—such as assessing and monitoring aquatic habitats, air quality, surface water and groundwater, wetlands, and watershed use," Program Director Theresa Chavez says. Students meet and work with their pueblo environmental departments throughout the school year.

Student teams make weekly treks to the pueblo communities (Cochiti, Jemez, Santa Clara, and Tesuque) to gather data and establish baseline information, as they develop and apply the academic and technical skills necessary to deal with their current topic. Students use scientific equipment to sample and monitor the quality of air, soil, water, and biological specimens. For example, students have learned to use computer technologies, geographic information systems, and global positioning systems. They regularly use the Internet as a research tool.

Students conduct historical research and create photographic archives of pueblo cultural resources (sites and artifacts). They also learn about regulations and laws that protect the public

*Irene Nakai. "Bridge Perspective." *The South Corner of Time: Hopi Navajo Papago Yaqui Tribal Literature*. Larry Evers, Ed. Tucson: University of Arizona Press, 1980, page 91. Used with permission.

and the environment. These young Native Americans, in turn, educate their friends, family members, and communities about how and why the environment is monitored.

Says Mark Ericson, a science and environment teacher, "Students develop the knowledge that comes with experiential learning and work toward resolution of community issues and problems." They are excited about their work in the pueblo communities. Math and science test scores have improved. Theresa Chavez sums up, "We're proud of the kids; they're leaving here with confidence, they all find their place in here, they all become experts in something."

Several students agree they like to "work closely with the pueblo elders." Josh, one enthusiastic student who has participated in the program for two years, says, "It gets your brain thinking how you can be part of it—be part of the solution."

Students have participated in summer sessions at the Laboratory and have presented posters to demonstrate their work. Here students sample and analyze the quality of air, water, and biological specimens.

The Weather Machine: A Boon for All Seasons

The weather in Los Alamos is about more than skiing and hiking: health and habitats may depend on which way the wind blows.

The dramatic storms in New Mexico are complex—dark clouds weaving among the plateaus, light falling in broken patterns on the mountains, billion-volt lightning crackling across the horizon. These storms are influenced by the extreme terrain around Los Alamos, which creates turbulent microclimates.

Beautiful certainly, but a challenge for researchers at the Laboratory. Even on calm days, they need to know whether to conduct an open-air explosives test, how to prepare for the potential of accidental chemical or radioactive releases, and when to correct for atmospheric effects on delicate experiments and equipment. The Laboratory is also active in fire risk assessment, ecosystem management, and pollution control, all of which are influenced by environmental conditions, and all of which concern everyone in northern New Mexico. Since the Cerro Grande fire burned away vegetation that had previously slowed the flow of rainwater down the plateau's cascade of canyons, weather forecasting for flood warnings and flood management has taken on an even more vital role at the Laboratory.

Enter the Weather Machine, a computer network that monitors and analyzes data from six reporting stations. It was designed to help the Laboratory manage its activities and to offer the Laboratory's expertise to its neighbors. Available to everyone through its Internet Web site at *http://www.weather.lanl.gov,* the Weather Machine provides current conditions and forecasts, as well as historical data for research, by connecting six towers around the Laboratory with a set of computers. The Web site is linked to the National Weather Service and the National Center for Atmospheric Research, allowing the site to provide regional and national information.

Users of the Weather Machine's site come from everywhere: they may be Laboratory employees, private citizens, or representatives of universities, government offices, or businesses. Over 1,000 of these connections are made every workday, a fourth of them from outside the Laboratory. Researchers can also request sets of data to calculate phenomena such as air pollution dispersion or long-term rainfall. Hundreds of research requests come in every year.

Beyond responding to these incoming requests, the Weather Machine also sends out area and zone forecasts automatically by fax or e-mail up to three times a day, seven days a week, to a variety of customers, including the Laboratory's Emergency Management and Response Group and a selection of Los Alamos County organizations.

In its earliest days, weather monitoring at the Laboratory was simply a task required by the Department of Energy. It has grown into the Weather Machine, still serving its original mission but now also helping communities far beyond the Laboratory's borders.

Lightning. Even the word can make the back of your neck tingle.

Two hundred fifty years ago, Benjamin Franklin went in search of lightning. He tied a key to a kite and walked out into a storm, tempting a direct confrontation with nature's electrical display. It was a dangerous way to learn about lightning and not one we should copy.

For the average person, lightning is best appreciated from a safe distance. How close is too close? You'll know by the tingle at the back of your neck.

If you are ever near a storm, and you feel that tingle, take immediate action to protect yourself. If no cover is available, stay on the balls of your feet and squat down close to the ground without making too much contact with it. Don't touch any metal objects—and don't use an umbrella!

Every second of every day, lightning hits Earth about fifty times, a single bolt delivering millions or even billions of volts of electricity. In the United States, New Mexico is second only to Florida in annual lightning strikes.

Understanding and even predicting lightning is vital to the Laboratory and to all of New Mexico: the arid desert climate means high fire risks. Los Alamos researchers have developed a ground-based network, the Sferic Array, to measure electrical changes near thunderstorms likely to produce lightning. The array has a total of eleven stations: four in New Mexico, one in Texas, one in Nebraska, and five in Florida, including one at Cape Canaveral.

Exploring lightning has come a long way since Ben Franklin flew his famous kite.

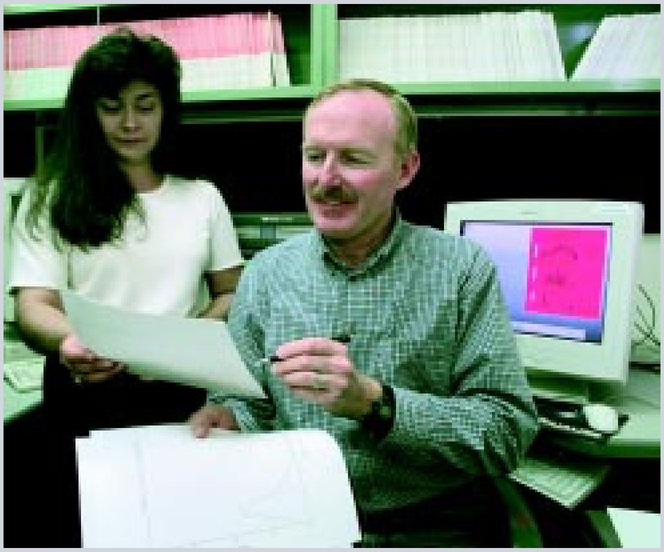
Instruments on the Weather Machine towers are over 95% effective in capturing data, thanks to instrumentation technician Bill Olsen. Here, Olsen climbs the 32-meter Pajarito Mountain tower to do repairs—after a lengthy check-out with the group safety committee and its hazard control plan. His blue protective gear is required for working near the cell phone antennae, which has the potential to emit radio signals at hazardous levels. Meteorological instuments were added to the tower to provide mountain top weather data to complement data from the network of plateau towers.

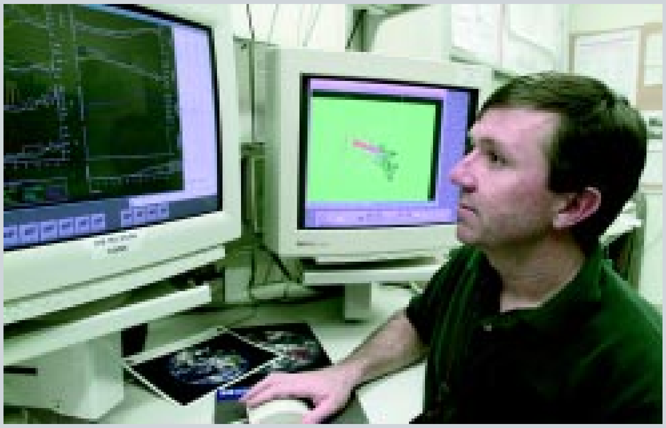
How It All Works

Technical Area 6 is the official weather station for Los Alamos and the Laboratory; it required minor repair following the Cerro Grande fire. The weather network has six towers: four on Pajarito Plateau, a fifth in Los Alamos Canyon, and a sixth on Pajarito Mountain. Besides these towers, there are also three precipitation monitors on the plateau.

This location also includes a sodar instrument (sound detection and ranging) that sends “blips” of sound into the upper atmosphere and interprets the echoes. It provides information on winds from the plateau up to local mountain top level, data especially useful in preparing for open-air explosive tests.

The Space and Atmospheric Sciences Group at Los Alamos maintains a ground-based system that makes lightning information available to the public.





Darrell Holt (top right) is a meterologist at the Weather Machine, and Melissa Coronado (top left) is the system administrator.

Weather information from the towers comes into these computers at 15-minute intervals and is interpreted and made available to the public.

The Weather Machine is linked to the National Center for Atmospheric Research in Boulder, Colorado, which provides high-quality images for the "big picture" reports beamed in from satellite observations.

Meteorologist George Fenton (above) of the Laboratory's Air Quality Group interprets the data from the network and applies meteorological tools to describe and forecast local conditions and present the information on the Web site.

Over the years, the Weather Machine has added many new features. By 1993, the Web site was available, making the data easily accessible.

A key goal of meteorological monitoring at Department of Energy sites is to predict how the potential plumes of chemical or radioactive materials would disperse in the event of an accidental release. MIDAS (Meterological Information and Dispersion Assessment System) models such plumes, providing emergency-response personnel with information for decisions about protective activities, such as sheltering or evacuation.

Shown above, MIDAS uses data available on the Weather Machine to model a plume. Laboratory groups also conduct an annual exercise to be sure they are ready for any emergency.

Nonnuclear hydrodynamic test.

Some experiments require the detonation of nonnuclear explosives outdoors. Laboratory employees are required to consult the Weather Machine and other weather sources before and during these operations. Lightning, high winds, and heavy rain regularly change the timing of explosive shots.

Eliminating Legacy Materials

Most New Mexicans have a variety of chemicals around their homes: paint thinner from last summer's house painting, insecticides to combat an ant invasion, and other chemicals that represent a legacy of the never-ending work of household maintenance. Scientific experiments can also produce a bewildering array of chemicals that were once important for experiments or projects. These legacy chemicals, whether in the home or in a laboratory, can pose hazards and should be disposed of properly.

Following Director John Browne's 1997 directive, the Laboratory is improving performance in environmental protection, awareness, and compliance with state and federal environmental regulations. As a result of Laboratory self-assessments and state and federal inspections, problems with legacy chemicals have been identified throughout the Laboratory. These chemicals have been stored for years after being used in experiments by scientists.

A plan was developed in January 1998 to identify, remove, and properly dispose of legacy materials on Laboratory property. A legacy materials team was assembled that included experts in radiation protection, industrial hygiene and safety, hazardous material handling, and other environmental arenas. The team's goal was to sample, analyze, characterize, and dispose of legacy materials found at the Laboratory—in a seemingly impossible nine-month period. At the same time, Laboratory divisions began a thorough search to identify, inventory, and collect any chemicals that were no longer needed.

The legacy materials team began its work in February 1998. In the months that followed, the team examined every site where the Laboratory had identified legacy materials. All legacy materials were disposed of through the Laboratory's program for reuse of excess materials; the Laboratory's treatment, storage, and disposal facility; or off-site treatment and disposal facilities. The legacy project met its scheduled completion date on September 30, 1998. The team ultimately processed more than 22,500 items, only a fraction of which had to go through the sampling and analysis process.

The Laboratory has taken decisive steps to prevent further accumulation of legacy materials. Waste minimization efforts require ordering only what is needed and replacing hazardous with nonhazardous chemicals whenever possible. A new chemical management system is being developed to track chemicals from initial purchase to final disposition.

The legacy materials cleanup project is not only a good example of the Laboratory's effort to meet the requirements of New Mexico environmental laws and regulations of the Resource Conservation and Recovery Act, but it's also a step in the direction of a healthy environmental legacy for future generations.

Detective Dustie

During more than five decades of scientific experiments at Laboratory facilities, researchers have produced a variety of legacy materials occasionally found in old bottles or containers with time-faded or illegible labels. Some containers are simply labeled numerically or alphabetically, but the experimenter who devised the labeling system is no longer at the Laboratory to identify their contents.

When a puzzling container is found, a radiological control technician first monitors it and provides guidance for the next step. This is where environment, safety, and health technician Dustie Stephens comes in. Clad in a lab coat, safety glasses, and gloves–and sometimes outfitted with a respirator–Dustie obtains a sample. Her job is to send the sample to an analytical laboratory for characterization or to perform a chemical analysis herself.

While performing a chemical analysis, she carefully follows a step-by-step procedure to determine exactly what is in a mixture. One step tests for chlorinated compounds, and Dustie can tell by the presence of a green flame that such a compound is present.

She's seen some strange concoctions: once, there were photochemical compounds in milk cartons; another time, a substance turned out to be iced tea in an old gallon jar.

On one occasion, she was called to identify something that, she says, "was oozing green stuff, like in the movie *The Blob.*"

Recently, the mysterious, dark, ugly content of a baby food jar was found to be homemade berry jelly that had burned in the Cerro Grande fire.

Dustie, who received a Laboratory Distinguished Performance Award for her work on this project, is well suited to fast-paced duties. She brings energy and a sense of humor to her sometimes stressful job of quickly and accurately analyzing unknown materials. In her favorite pastimes of archery and horseback riding, she has hobbies that require the same focused skill. Away from work, she is no couch potato, rarely watches television, and prefers active leisure time and volunteer work. She sponsors a 4-H club and a children's riding club and assists with the therapeutic riding program for handicapped individuals. She and her daughter traveled to Ireland last summer to celebrate her daughter's high-school graduation—another adventure for the curious explorer.

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SANTA FE, NEW MEXICO 87503

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GOVERNOR

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The new millennium has brought the Western United States wildfires on a magnitude that will be recorded as one of the most destructive in history. Our state has seen vast areas of New Mexico destroyed, leaving many neighbors homeless, yet we have pulled together and are working daily to mitigate the overwhelming devastation left by these fires.

The Cerro Grande fire stands as the single most destructive wildfire in our state's history. As governor, I spent four days in Los Alamos, seeing first-hand what was occurring so I could better coordinate state resources in fighting the fire. Now that the fire is out, we face the threat of flooding. The National Forest Service, National Park Service, the Laboratory, and the community have initiated numerous efforts to protect our homes and the environment. Cleanup and rebuilding efforts will be ongoing for many years. Although the scars will remain for many generations, the forests will return and future generations will benefit from what we have learned from this crisis.

The fire damaged the forest, the Los Alamos National Laboratory, surrounding pueblo lands, and the community of Los Alamos. While many of us were worried about the hazardous materials used at the Laboratory, we found they were well protected and did not pose a threat to the surrounding communities or our beautiful mountains and streams. As I worked with the people of the Laboratory, and the County of Los Alamos, I gained a fuller appreciation for their concerns in protecting the public and the environment. The Laboratory is a tremendous national resource and we are proud to have New Mexico provide its home.

On behalf of the citizens of New Mexico, I thank the Laboratory for all it does for the State of New Mexico and particularly for their efforts during the Cerro Grande fire.

Sincerely,

Gary E. Johnson
Governor

The Beauty and the Beast

When we lose our beloved trees, yes, we must grieve.
But in our grief we must also look beyond the dead trees
and see what is yet to come.

—T. S. Foxx, Los Alamos National Laboratory (retired)

In past issues of this publication, we've discussed the dense, overgrown forest imminently threatening to explode into a catastrophic wildfire. The fact that a wildfire did occur was not surprising; the surprises are the total number of acres burned, the scale of destruction, and the devastating losses sustained by the town and the Laboratory. If not for the devastation wrought upon our townspeople and the damage to the Laboratory, the Cerro Grande fire would have been comparable to other recent wildfires. But devastation did occur; now we are all coping with loss and post-traumatic stress. We blame the wildfire and call it the beast.

Before the nationwide campaign to prevent forest fires, wildfires had a beneficial role to play in the sustenance of ponderosa pine forest. Periodic fires kept the tree density at a healthy level—about 100 trees per acre—allowed life-giving sunlight in, and provided nutrients to the soil. Patches of forest interspersed with meadows created habitats for a wide variety of plants and animals. In fact, certain species require periodic fires for better existence. Our country's policy of fire prevention fed the beast.

And human intervention ambushed the benefits of periodic fires. During the era of forest-fire suppression, ponderosa pine proliferated to 500, 800, even 1,200 trees per acre. Obviously, fire in a dense forest—especially when fanned by wind gusts—burns hotter and causes greater destruction than a fire in a healthy, thin forest. We blame the wildfire and call it the beast, when all along national policy has been providing the fuel.

The catastrophe has now befallen us. Blaming will not help. We must move forward. We must let the grieving process run its course. We must adjust to our losses. We must rebuild and repair. As we do so, let us recognize that the beast will show us the beauty of fire's benefits—perhaps more quickly in those areas not burned as severely.

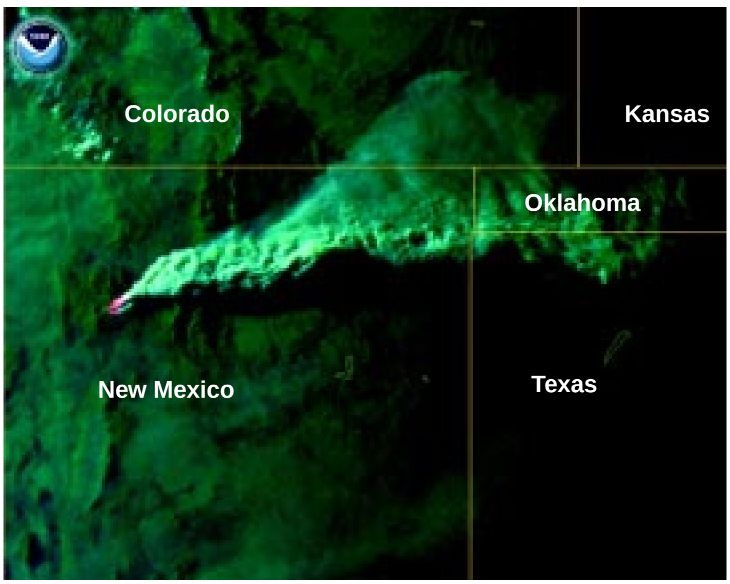
Almost immediately after the fire, grasses, aspen, and oak brush began sprouting. Within weeks, wildflowers like senecio and fireweed began blooming with more vibrant colors, thanks to the extra boost of nutrients provided by the fire. Next year we can anticipate huge colorful expanses of these and other wildflowers. Panoramas are revealed, showing ridgelines and rock faces once hidden in the density of trees, their beauty now available to us. The beauty and the beast go together. We must remember.

Smoky Details

Data indicate emissions from the Cerro Grande fire were consistent with those emissions expected from natural sources from burning vegetation and soils.

—SWEIS Yearbook, Wildfire 2000

The satellite image of the smoke plume from the Cerro Grande fire on national television was an incredible picture—it covered the northeast corner of New Mexico and parts of Colorado and Texas and spread into Oklahoma. General comments circulated that the plume must be supertoxic because the fire was burning in parts of the Laboratory where work is performed with radioactive material and high explosives. Some people in northern Colorado even packed up their belongings in preparation to flee for their lives if the plume were to change direction and head toward them.



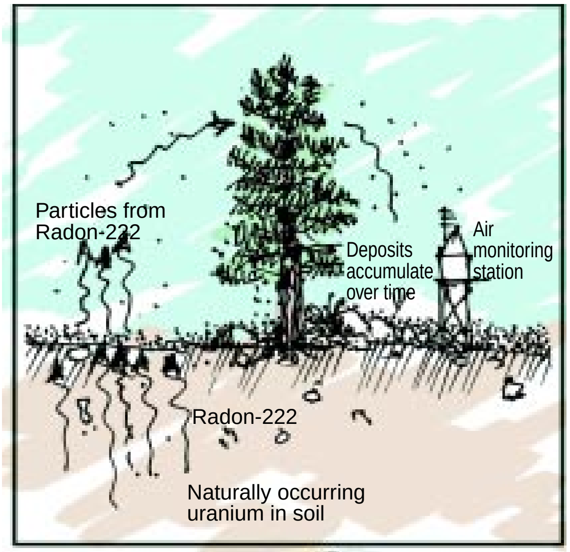
Of course, smoke from a wildland fire is not something you want to breathe for any extended period of time, but its components are really no different from what is contained in the smoke from a campfire—there's just more of it. And even though about 40 Laboratory structures (none of which housed dangerous substances) and over 200 dwellings (home to over 400 families) were destroyed, the Cerro Grande fire was considered a wildland fire because of the sheer immensity of the wildland involved. Hence, the contributing smoke from these structures made up only a very small proportion of the total plume.

Air monitoring by the Environmental Protection Agency, the New Mexico Environment Department, the Department of Energy, and the Laboratory took place during the whole time the fire was rampaging. The agencies had over 75 air monitoring stations—some designed to measure specific characteristics like gamma radiation or the number of particles in the air. Not one agency found the plume to contain anything out of the ordinary.

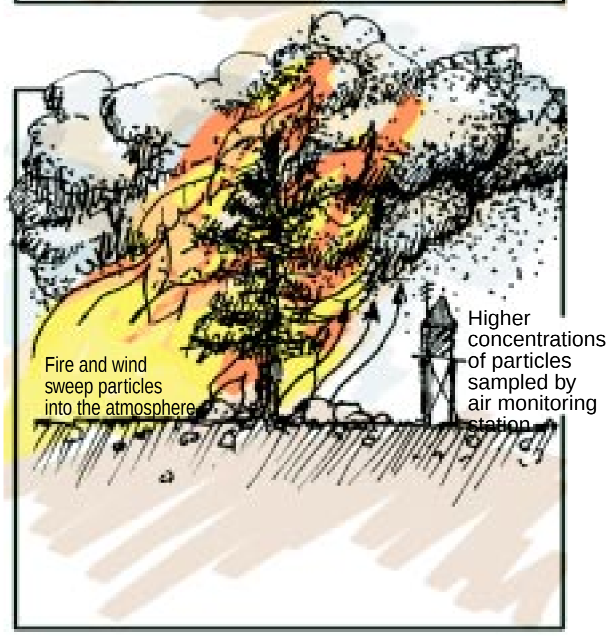
However, the "ordinary" includes particles, chemicals, metals, and radioactive material. Aside from the particles, which are a direct result of the fuel's actual burning, most of the other emissions are products of nature caught up in the fire along with everything else. For example, wildfires burn radon, a naturally occurring gas that decays into lead-210, bismuth-210, and polonium-210, which are radioactive.

As can be seen in the following illustrations, these decay products settle onto the ground or other surfaces, like plant leaves or grass blades. But when the flora itself is consumed in a fire, these radioactive materials become part of the smoke.

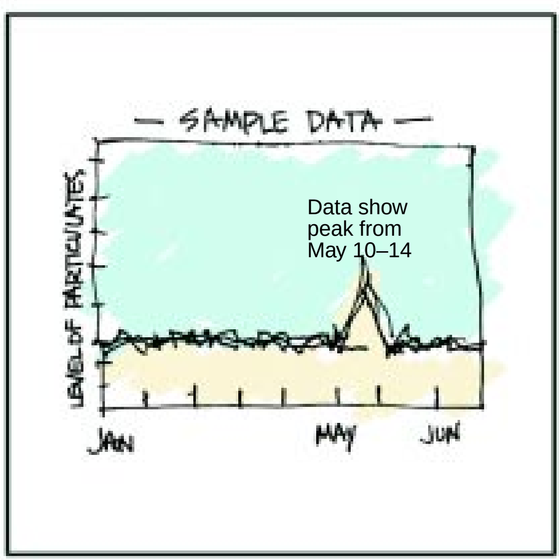
Misinformation or misunderstanding can cause needless worry and suffering and can sometimes lead people into troublesome situations. During a crisis, not only are people sometimes more vulnerable to misunderstanding because of fear and uncertainty, but also the misinformation, the stories, and the rumors can achieve truly fantastic proportions. Those of us who experienced this crisis probably have some interesting anecdotes that we could share.



Before the fire—naturally occurring uranium in soil produces radon-222, a gas that decays into radioactive particles that circulate in the atmosphere. Deposits of these particles accumulate over time throughout the environment.



During the fire—the agitation of the total environment by the elements, including fire and wind, dramatically increases the amount of radon decay products circulating in the atmosphere.



After the fire—data analysis reveals the increase in radon decay products during the fire reflects increased circulation of naturally occurring radon decay products in the atmosphere.

Air Monitoring During the Cerro Grande Fire

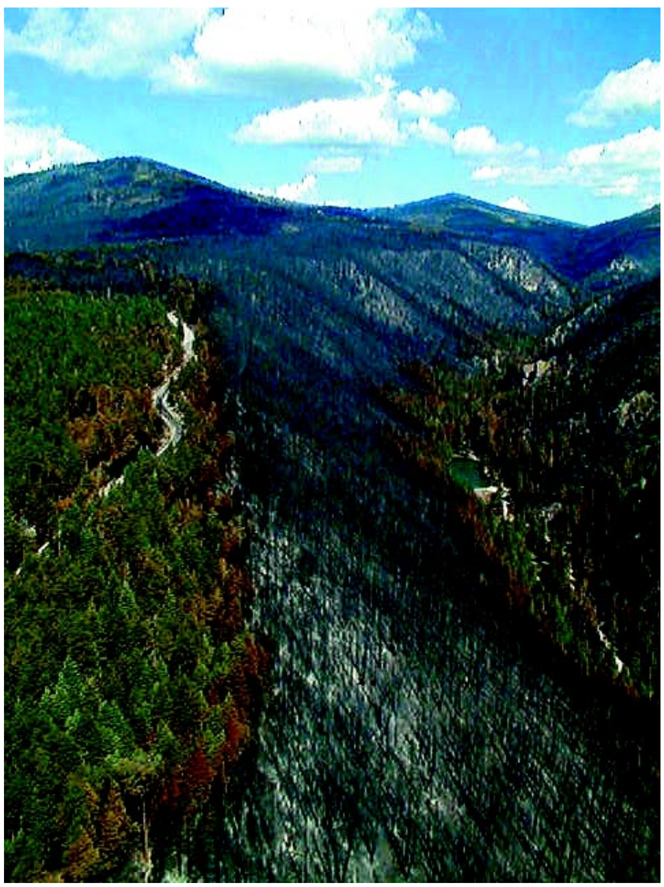
New Mexico Environment Department	
ERMAS (with the Environmental Protection Agency)	ERMAS is a particulate air sampler atop the PERA Building in Santa Fe. It is part of a nationwide network that checked for beta and gamma radiation during the fire. A portable sampler was also set up in Española from May 14 to May 16.
RAD Monitors	Monitors around the Laboratory and in neighboring communities checked for radioactive particles and gases.
Non-Rad Monitors	Monitors checked for particle matter smaller than 10 microns (called PM-10), which is small enough to inhale, with one monitor checking for particles smaller than 2.5 microns.
US Environmental Protection Agency	
EPA RAD	Twenty stations deployed at the Laboratory and in northern New Mexico checked for radioactive particles.
Non-Rad Monitors	Several monitors on Laboratory property and in surrounding areas checked for PM-10, volatile organic compounds, pesticides, and metals.
US Department of Energy	
Radiological Assistance Program	This program consists of a team of individuals with remote monitors that looked for radioactive particles and provided high-volume sampling with rapid turnaround analysis.
Los Alamos National Laboratory	
AIRNET	Fifty stations around the Laboratory and in neighboring communities checked for radioactive particles and gases.
NEWNET	This is the Neighborhood Environmental Watch Network, which checked for gamma radiation. NEWNET is a community-based educational tool.
PM-10 Monitor	This monitor checked for PM-10.

Complete results of air monitoring during the Cerro Grande fire can be found at http://www.air-quality.lanl.gov/CerroGrandeFire.htm

First Fire, Now Flood?

Northern New Mexico residents may feel as if the new century has ushered in fire, flood, and general disaster. In May 2000, after the Cerro Grande fire stripped over 40,000 acres of forest and ground cover around Los Alamos, the surrounding communities and the Laboratory were in extreme danger of flooding. July and August are the rainy months when the area typically receives over one-third of its annual rainfall. Because of the fire's intense heat, almost twenty percent of the burned land became hydrophobic, the ground unable to absorb water, especially the heavy rains that were expected.

Environmental rehabilitation workers knew that summer rains on the high-desert plateau could become torrents raging down the canyons. Of course, the main concern is always to protect human life, but given the unique qualities of the area, there were other concerns. Protection of Laboratory property, archeological and historic sites, as well as habitat for threatened and endangered species became high priorities.



Los Alamos Canyon with reservoir (at center right) before it was drained.

Another issue was legacy soil contamination. The possibility of flooding renewed anxiety about hazardous, toxic, and radioactive material remaining in the canyon sediments from Laboratory operations in the 1940s and 1950s. If rainwater washed away the protective soils, contaminants could be carried into the Rio Grande.[1] Because in many areas the forest canopy and forest floor had been burned away, there were increased flood flows and increased potential for soil erosion.

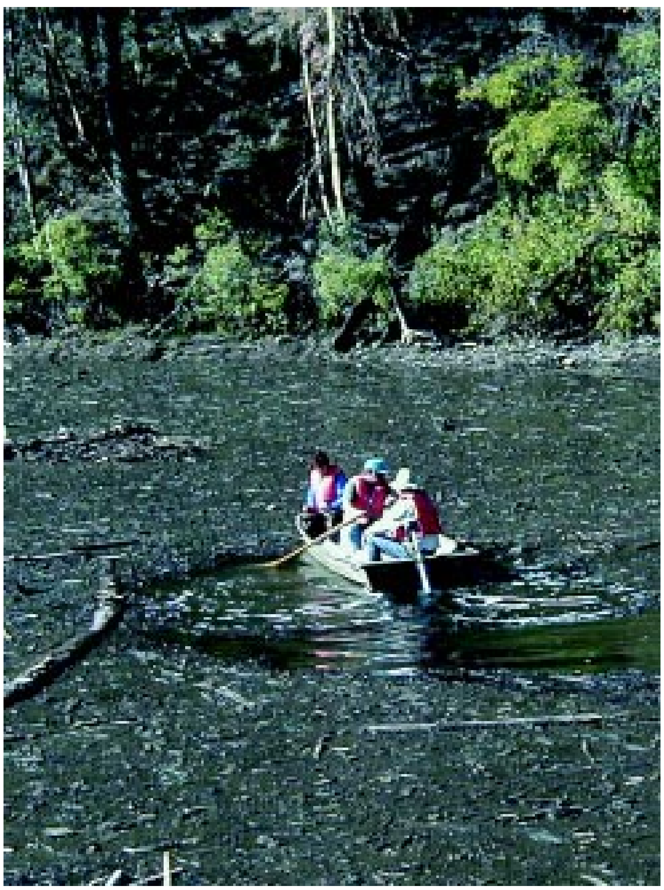
Soon after the community and Laboratory reopened in late May, workers raced Mother Nature to reduce the potential for severe flooding. They tracked watershed damage and created detailed maps to guide rehabilitation efforts. Crews of workers broadcast seed and spiked straw into the scorched ground. The environmental rehabilitation workers—along with community volunteers—raked, mulched, planted grass seed, placed straw bales and wattles (long sausage-looking tubes of hay used to slow fast-moving water and trap sediments), felled dangerous, sometimes smoldering trees, and shored up runoff channels to prepare for the rains. Flood prevention involved mulching and reseeding from the air—pilots flew over the burned areas and dropped seed and hydromulch.

Laboratory personnel prioritized work on the watersheds affected by the fire based on known or suspected contaminants and operations as well as the potential for flooding. The three highest priority watersheds were Pueblo, Los Alamos, and Pajarito Canyons. Flood control measures were implemented both on and off Laboratory property. The reservoir in Los Alamos Canyon was drained; rock check dams, weirs, and other barriers were put in place;

and culverts were enlarged so runoff from the rains was not blocked.

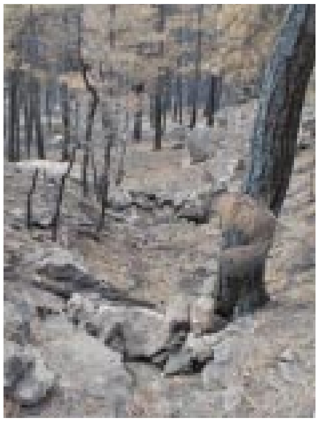
The Department of Energy hired the US Army Corps of Engineers to assist with flood mitigation measures. The Corps handled the construction of a flood-retention structure in Pajarito Canyon. The 75-foot-high dike—a rolled, compacted concrete structure upstream of Technical Area 18—is designed to slow heavy stream flows and to prevent flooding downstream at Technical Area 18.

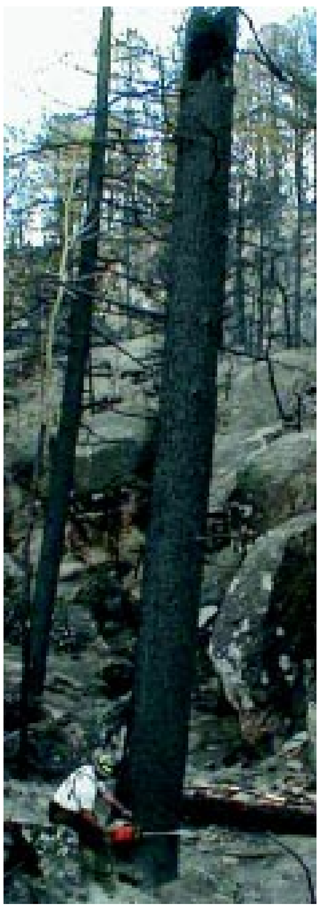
Although there were some heavy rains during the summer, the worst-case scenarios were averted. The enormous scale of destruction from the Cerro Grande fire means that the dangers of potential flooding will be with us for several years. Flood prevention, runoff control, and environmental rehabilitation efforts will continue.



Heavy rainfalls in June, July, and August created substantially higher flows of water and flash floods. Above: Los Alamos Reservoir, after it had been drained, quickly filled with debris carried by the runoff. On the right (top to bottom): Flood waters rush down Rendija Canyon, wash out the road, and clog a culvert with thick ash and debris.

[1] As this article was going to press, Laboratory hydrologists reported that some stormwater samples show the presence of heightened levels of fallout radionuclides and cyanide. After reviewing research regarding forest-fire-created contaminants, hydrologists found scientific data that indicate quantities of cyanide can be produced naturally by a smoldering fire. Los Alamos researchers are collaborating with researchers from the Environmental Protection Agency, New Mexico Environment Department, and the US Forest Service to compare samples collected here with samples collected at other nearby fire-damaged areas. Los Alamos hydrologists will continue to test for and report on cyanide and other substances of concern in runoff.





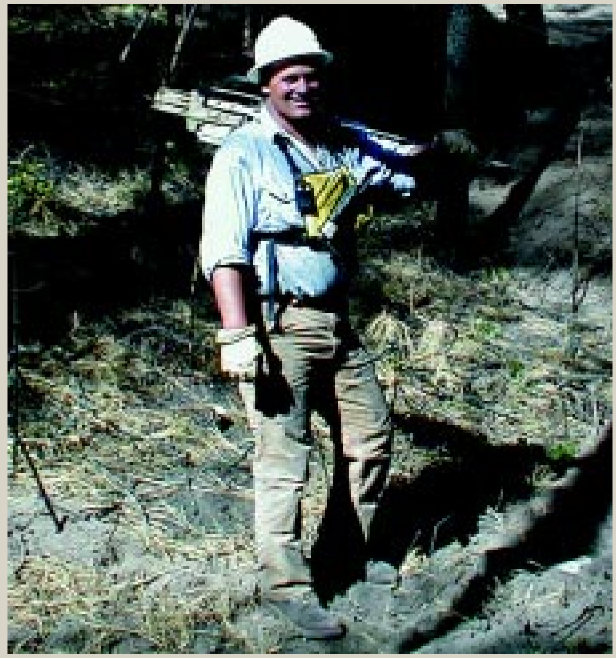
Clockwise from top left: Rock check dams will slow the runoff after rain.

Aerial hydromulching was used to reduce erosion on steep slopes.

The Army Corps of Engineers supervised the construction of a flood-retention structure in Pajarito Canyon.

A worker fells a hazardous tree that was still smoldering ten days after the fire.

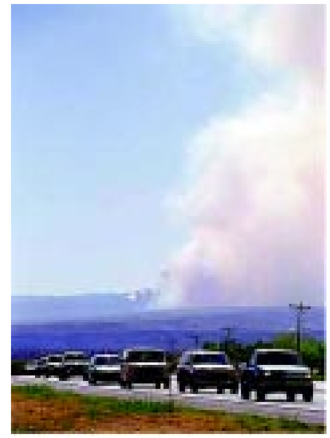
Several strategies are used to reduce the risk of flooding, such as culvert maintenance (top), wattle placement (middle), and weir installation (bottom).



Jeff Walterscheid

Jeff Walterscheid, who helped supervise environmental rehabilitation work in the burned areas of the Laboratory, reported some harrowing experiences during the summer flash floods. He said boulders dislodged by rains rolled over State Road 501 at Starmers Gulch, and he described hearing boulders roar down the canyon slopes and feeling the ground shake in upper Rendija Canyon.

Jeff, a lifelong resident of Los Alamos, put into words what many people feel. When asked about his level of fatigue after long weeks of hard work in the burned-out forest and canyons, he said, "Sometimes, when I was standing knee-deep in ash and looked up to the burned hills, I thought about how it looked when I was growing up … and tears came to my eyes. But I knew we had to keep going and keep working to help save what's left."



Risk Management Makes a Difference

In early May 2000, as a boiling black cloud of smoke churned up into the sky and rolled down the canyons and across the mesas of the Pajarito Plateau, many people feared that the Cerro Grande fire was burning Los Alamos National Laboratory, endangering human life and wildlife habitats with high explosives, radioactive waste, and other contaminants. After the fire was reduced to a smolder, questions intensified about the Laboratory site and about contaminants that might have been released. What had burned at the Laboratory? Had the public been exposed to dangerous levels of radiation and chemicals? What about the plutonium and hazardous waste on Laboratory property? Many northern New Mexico residents as well as the news media, public officials, environmental groups, members of Congress, and the Department of Energy demanded answers.

The impact of the horrendous firestorm on Laboratory property was reduced—thanks to community awareness and Laboratory foresight, planning, and risk management. It's true, the Laboratory suffered damage to property and equipment, but almost miraculously, there were no serious injuries or deaths. More than one hundred buildings were damaged, and some valuable research data, stored on computers that burned, were lost. Also, because the Laboratory was closed for two weeks and researchers could not tend experiments, some lost years of work.

History burned too. The fire destroyed five structures from the Manhattan Project where parts of the Trinity atomic bomb were assembled during World War II. Formerly known as V-Site, the five buildings were constructed in 1944 and had recently been named an Official Project of the White House Millennium Council's Save America's Treasures program. None of the buildings had been used since the 1950s.

Lessons learned from the 1977 and 1996 fires helped to prepare the Laboratory and the Los Alamos community for the Cerro Grande fire. This most recent fire demonstrates the risk of inaction and the benefit of proactive risk management. After a close call from the 1996 wildfire, the Laboratory reassessed its forests and the fire risk to personnel, buildings, and operations. The Laboratory and the Department of Energy formed an interagency wildfire management team with neighboring land agencies and reestablished fire access roads, thinned trees, constructed a helicopter base, and built a firefighting supply cache. These preventive actions curtailed the damage from the Cerro Grande fire.

The interagency management team also sponsored a fire awareness program for the public in April just a week before the fire. The calm, orderly evacuation of the Los Alamos community occurred on May 10. Community awareness certainly contributed to the safe evacuation of both Los Alamos and, later that night, White Rock.

Laboratory efforts to establish green areas by clearing underbrush and trees significantly decreased the impact of the fire, especially around key sites that could pose a danger to the public. For example, in spite of some close calls, the fire did not burn over Technical Areas 54 and 55, sites with hazardous waste and plutonium.

Proactive risk management also considers wildlife habitats. The fire altered the habitat and migration patterns of many animals. During the summer, wildlife, including bears, snakes, mountain lions, and deer, were more visible as they moved to unburned areas in search of food and shelter.

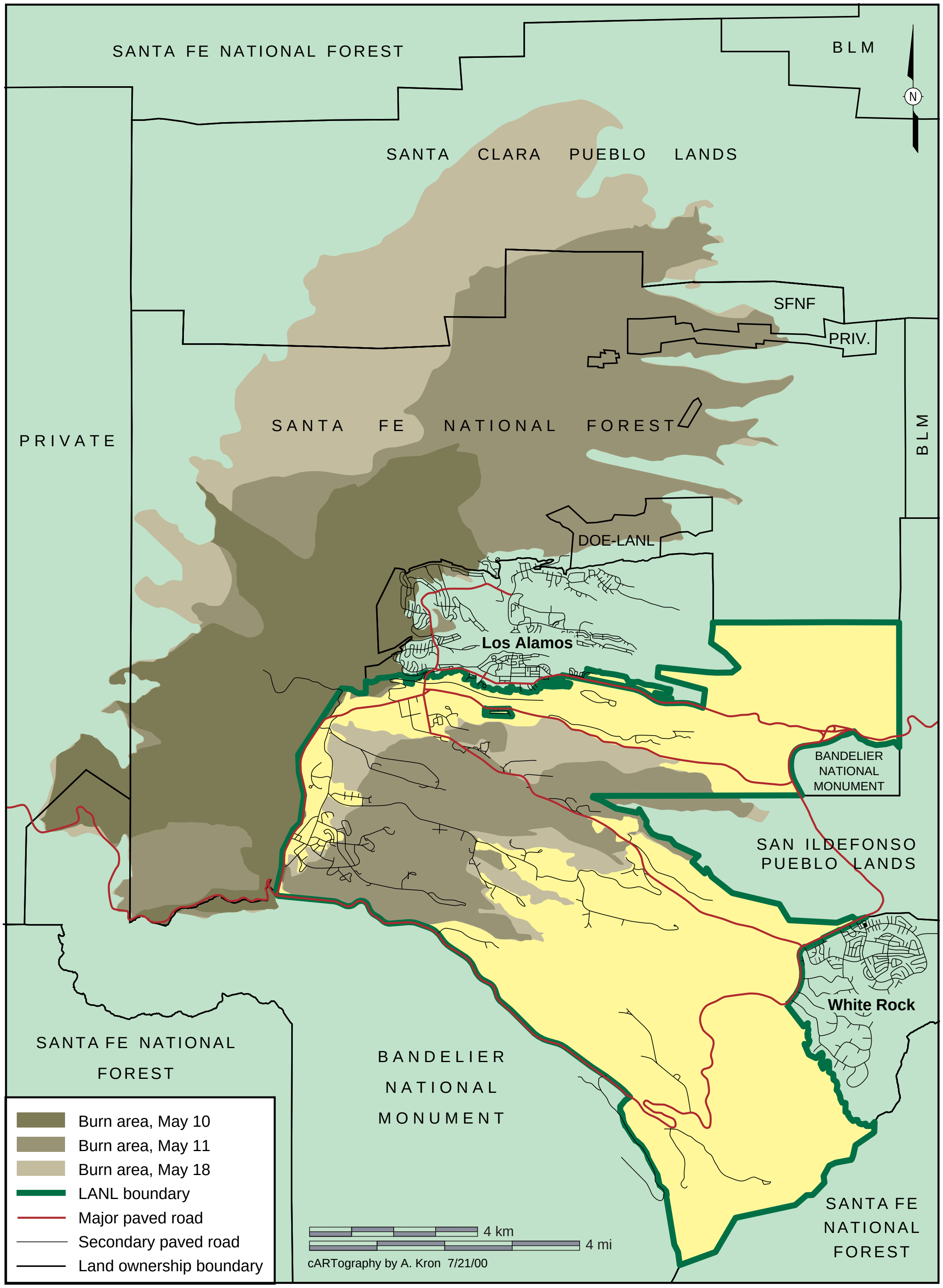
However, the fire's aftermath will eventually benefit most habitats. The endangered Mexican spotted owls have returned to their nesting area, their habitat now enhanced by the fire's forest-thinning effect. The elk herd came back to its winter grazing grounds. The thinned, open forest means shrubs and grasses are coming back stronger, and the herd is likely to thrive.

The fire burned about one-quarter of the Laboratory land, and smoke and ash traveled many miles. In response to our neighbors' concerns, we collected more types of samples, sampled more frequently, and analyzed more constituents. We sampled soils and foodstuffs from area farms and ash and wood in addition to our normal suite of biota and foodstuffs.

Preliminary results indicate that Cerro Grande fire emissions mirror those from any large forest fire. Neither radioactive nor chemical contaminants were released in excess of what would be expected during a fire.

Although the Cerro Grande fire was a disastrous event for the Los Alamos community and northern New Mexico, the catastrophe claimed no human lives and damage to property was reduced because of effective risk management.

The Cerro Grande fire destroyed five Manhattan Project-era buildings at what once was called V-Site. The building in the center is the Trinity Assembly Building, where, in a daylong assembly marathon on July 12, 1945, shaped chunks of high explosives were carefully fitted together. They were then taken to Trinity Site in southern New Mexico where they were combined with nuclear materials and were tested on July 16, the world's first explosion of an atomic device. The Army Corps of Engineers constructed the buildings in 1944, but none had been used since the 1950s; they were slated to receive official national historic status before the fire.



After burning for seven days, on May 10 the Cerro Grande fire split into two fronts, one north into Los Alamos and beyond and one east into Laboratory property. The fire progressed north and east overnight and crossed Laboratory boundaries into San Ildefonso Pueblo land on May 11. Before May 18, the fire stopped progressing on Laboratory land, but continued burning on national forest and land belonging to Santa Clara Pueblo until containment on June 6. The Forest Service declared the fire controlled on July 20, 2000.

Thank You, Volunteers!

True belonging is born of relationships not only to one another but to a place of shared responsibilities and benefits. We love not so much what we have acquired as what we have made and whom we have made it with.

—Robert Finch, from "Scratchings," *The Primal Place, 1983*

Los Alamos now belongs to northern New Mexico as it never has before. During the Cerro Grande fire and the evacuation of Los Alamos and White Rock, old ties were strengthened and new connections were formed. Thousands of New Mexicans rallied to help house, clothe, and feed evacuees. High-school seniors rescheduled proms when their gyms were turned into disaster shelters. People brought toys and blankets to shelters, sent toiletries and clean socks to the firefighters, and gave money to help people whose homes had burned.

Volunteers remained crucial to recovery after the fire. For several weekends, people pitched in on the hot, physical work of ecological recovery and flood mitigation. Forest Service personnel indicated that the volunteer effort was unlike anything they'd seen before, as people turned out by the hundreds to help.

Al Toth, a detective with Los Alamos Police Department, helped coordinate efforts with the Forest Service, the Park Service, the Natural Resources Conservation Service, and the Laboratory for work on National Forest and County lands. Volunteers raked, seeded, mulched, cleared drainage paths, and installed straw wattles—long sausage-looking tubes of hay used to slow fast-moving water and trap sediments. Volunteers quickly covered so much area that it was hard to keep up with demands for hay.

Says Al, "When we started out, we chose sites that didn't require too much hiking and where the slopes weren't very steep. As we went along, we discovered that people were capable of more, so we worked on steeper slopes with longer hikes to the work sites."

Mike Frazier of the Forest Service said, "We typically don't allow volunteers into an area with an uncontrolled fire, but we could let people work in areas that were no longer hot. We also followed all the rules that would help prevent injury, including a job hazard description. Even with more than 16,000 volunteer hours, no one was injured, although quite a few people ended up with blisters and sore backs."

For the Laboratory, flooding was a major concern—not only because of what might move off Laboratory property but also what might travel down from Forest Service land. Laboratory volunteers were needed to help with rehabilitation and flood mitigation on Laboratory property.

"We ended up with around 150 people," said Phil Thullen, who headed up the Laboratory's volunteer effort. "These volunteers first worked with Forest Service personnel on Forest Service land, which not only assisted with overall rehabilitation efforts but also trained employees for work on Laboratory property."

"The diversity of people in the groups was impressive," said Phil, "we had men, women, students, and more seasoned employees, employees who lived within Los Alamos boundaries and those outside it, and people from different Lab organizations."

Overall, the volunteer efforts worked so well that fresh Forest Service crews coming in were skeptical. "They didn't believe that we were getting as many volunteers as we were and that they were accomplishing so much," said Al, "it wasn't until they got here themselves that they had a chance to see what we accomplished."

As the months go by and the natural processes take place, we can see new growth coming in and imagine how beautiful the area will look in the future. We can then fully appreciate the volunteer efforts and be truly thankful.

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Los Alamos National Laboratory was established in 1943 as Project Y of the Manhattan Engineer District. Under the leadership of J. Robert Oppenheimer, the Laboratory developed the world's first atomic bomb. Today, Los Alamos is a multidisciplinary, multiprogram laboratory whose central mission still revolves around national security.

Managed by the University of California for the US Department of Energy, the Laboratory maintains a commitment to its tradition of free inquiry and debate, which is essential to any scientific undertaking. Located on the Pajarito Plateau about 35 miles northwest of Santa Fe, the capital of New Mexico, Los Alamos National Laboratory is one of 28 Department of Energy laboratories across the country.

The Laboratory covers more than 43 square miles of mesas and canyons in northern New Mexico. As the largest institution and the largest employer in the area, the Laboratory has approximately 7000 University of California employees plus approximately 1000 contractor personnel. Our annual budget is approximately $1.3 billion.

Photo negative numbers are available for the following images.

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